A STUDY OF THE VALUE OF A SELF-INSTRUCTION TEST AS A TRAINING AID

by

LODORICK PETER TROILO

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INTRODUCTION

This experiment was conducted to determine the value of a technique applicable to an industrial situation, whereby instruction in safety could be made more effective.

There were on hand a number of devices which would indicate immediately whether a chosen answer was correct or incorrect. From among these scoring devices was chosen the self-checking Chemo-Score Answer Sheet.[1] This type of test has been established as being of real value in the classroom and home study situation. Therefore, it was thought that this kind of a device would be helpful in answering questions where an immediate knowledge of whether or not a chosen answer was correct may be of great importance. In the field of highway safety there are numerous important questions to which correct answers can be identified and fortified by the means of this check. Therefore, it was felt that this might be worth an experimental try out.

The value of this immediate check-up device has been established by H. J. Peterson[2] in his experiment on classroom learning. This study will be cited more fully in the discussion of this writer's experiment.

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[1] Devised by H. J. Peterson and J. C. Peterson, and described by the latter as "A New Device for Use in Teaching, Testing, and Research in Learning" in the Transactions of the Kansas Academy of Science, 33:41-47. 1930.

[2] H. J. Peterson, "The Value of Automatic Guidance in Learning" Reported A.A.A.S. Annual Meeting, 1935.

B. H. Fleenor's[1] experiment with students enrolled in home study courses has established the immediate check-up as a real aid in learning. He has shown that the self-instructor method of studying psychology is more effective than the usual method used in home study courses. The usual method for completing a home study lesson is a long, drawn-out written lesson which is time-consuming for both the student and the instructor.

J. C. Peterson's[2] study of the value of the Chemo-Score Answer Sheet showed that the average of the groups who used this feature of the device in reading, gained from 2.4 to 3 times as much in information as did those who used only the questions as a guide.

Since the value of the device has been established in situations of a long-run nature, it was this writer's desire to learn the advantage of the immediate check-up in a classroom situation over a short period of time. The experiment was set up to take a part of one class period, one full class, and a part of a third class period with about 40 minutes of this time devoted to the use of the self-checking device. The experiment was to cover just one assignment and the students were not told this was to be included in their grade in this course until after they had taken the pretest.

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[1] B. H. Fleenor, "Self-Instructor Grows in Popularity with Psychology Home Study Students", Kansas Industrialist, June 14, 1933.

[2] J. C. Peterson, "The Value of Guidance in Reading for Information", Transactions of the Kansas Academy of Science, 34:291-296. 1931.

MATERIALS AND METHODS

This experiment in learning covered material appearing in two different books, Hamilton and Thurstone[1] (1939) and Viteles[2] (1943). These two volumes were chosen because of their coverage of some factors involved in highway safety. The subject of highway safety was chosen because of the prominence it has or should have in our everyday lives. Also, the goals and procedures involved in learning safe conduct on the highway are pertinent to the learning of factors of safety in industrial work.

The experiment was set up to include a preliminary test in which the abilities of the two study groups could be compared. The experiment also included a study test constructed in two parts so that students might have an opportunity for separate use of each of the two study methods here in question. The two methods were, first, study by means of a text and guide questions where the student's chosen response was recorded on the Perfo-Score Answer Sheet; and second, study by means of the text and the guide questions where the chosen answers of the students were recorded on the self-checking Chemo-Score Answer Sheet. A final test was included in the experiment by which the learning resulting from each of the study methods could be measured. In the final, all questions from the study test were included.

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[1] J. R. Hamilton and L. L. Thurstone, Safe Driving, (New York: Doubleday, Doran) 1939.

[2] M. S. Viteles and others, Psychology for the Fighting Man, (Washington: Infantry Journal) 1943.

A preliminary test consisting of 75 questions was given to five class sections in General Psychology. This test consisted of 25 questions which appeared on the study tests and on the final examination, 25 questions which appeared on the final, and the remaining 25 which were not used again in study; but only as an indication of the relative abilities of the two study groups.

The study test questions were drawn from the references cited above and kept in separate sections. Each section contained 25 questions. The section which covered Hamilton and Thurstone (1939) had 12 questions from the pretest and 13 new questions. The section which covered Viteles (1943) had 13 questions from the pretest and 12 new questions. All of the questions on both sections of the study test were used in the final.

While taking the study tests, each class was divided into two groups. While one group was working on one set of questions, the other group was working on the other set. Each group used the Chemo-Score Answer Sheet on the first section of questions it studied, and the standard Perfo-Score Answer Sheet on the second section.

The class session, following the period which had been devoted to the taking of the study tests, was used for the administering of the final examination. The final consisted of 100 questions subdivided as follows: 25 questions which were in the pretest but not in the study test; 25 which were in the study sheets but not in the pretest; and 25 which were in the pretest, study, and final.

The pretest was given to the students prior to any information concerning the examinations which were to follow. The test was introduced to the class and the administrator asked the students to do as well as they could. After the pretest was over they were told that at a later date they would be given a chance to improve their scores. When the test papers had all been collected, the instructor gave the students the assignments to be read in the two books from which the experimental learning material was gathered. Here the students were told that during the next examination they would each have these two books at hand for reference; but it was emphasized that they should read them before taking the next test, for although both books would be available in class, it was pointed out that the references were too extensive to be read through in class. After all students had taken the pretest, they were told for purposes of motivation in the study test that some points would be added to their course grades, according to their performance in study. This allowance in points was set to be equivalent to the points of credit which could ordinarily be earned during this amount of study.

At the next meeting of the classes, the study tests were administered. Full instructions were given the students on the use of the Chemo-Score Answer Sheet. Each student was supplied with a pen and a bottle of clear, colorless liquid. A sample question was read to the class. They were told to answer the question by dipping the pen into the liquid and applying the point to the appropriate answer numeral on the answer sheet. Time was allowed for them to do this and observe the results. If the answer was

correct, a blue dot appeared when the liquid had moistened the chemically-treated answer numeral. If their chosen answer was incorrect, a red color appeared. They were told to stop and think about any question for which they had chosen the wrong answer; and if necessary, they were to refer back to their book before trying again. The administrator also told the students to stop and think about a question when the blue dot appeared, because this was the one fleeting moment when a question could be confidently fixed in mind for lasting retention.

The students were all practiced in the use of the Perfo answer sheet but none of the students had used the Chemo technique. Considerable difficulties are found in the manipulative and interpretative use of the Chemo-Score which are not found in the Perfo-Score. Since the Chemo-Score feature was new to all of the students, their responses were somewhat awkward at the beginning. It is probable that more practice in the use of this device would be necessary to achieve the full advantages that it might offer. However, the students were allowed time for only one practice question. To facilitate the writer's checking of students' responses, they were instructed to encircle the numeral designating the supposedly correct answer to each question. It was also the hope of the experimentor that this added movement would help to enforce the correct answer.

As soon as a student finished his set of questions with the Chemo-Score Answer Sheet, he was given the alternate set of study questions and told to answer them on the Perfo-Score Sheet as he would any other test with, of course, the privilege of assistance

from the book.

It should be noted here that some students were rushed for time. In that rush they made some excusable errors on the Chemo-Score Sheet by spilling the liquid on the sheet and as a result accidentally developing some wrong answer numerals. Errors were made also as a result of using too much liquid on the pen. This occasionally caused smears which added to the anxiety of some of the slower students. After the experiment was completed, it was felt that the students should have been more thoroughly familiarized with the working of the Chemo-Score before the actual study test period. Whatever relevent learning they had acquired in the first study test where the Chemo-Score device was used, was available for use in the second part of the test where only the Perfo-Score was used. This factor should have been controlled by having one study group use the Perfo-Score first. How far the results were vitiated by this omission can only be determined by further experimentation.

The final examination was administered by means of Perfo-Score Answer Sheets in the same manner as any other class test. The students were told that this was their final opportunity to show what they had learned.

RESULTS

The purpose in splitting each of the classes for the administration of the study tests was to allow each half of each class to serve as a control on the other half. The initial ability of

these two groups was checked by comparing their scores on the preliminary test. Group I scored a mean of 56.10±0.72 on the total 75 questions of the pretest while Group II scored a mean of 55.86±0.58. Their comparative abilities were also studied by comparing their scores on the 50 questions of the pretest which appeared on the final. On this group of 50 questions, Group I scored a mean of 31.22±0.84 with a median for this distribution of 31.88 as compared with a mean of 30.760±0.65 and a median of 31.33 for Group II. This would give a standard error of the difference between the means of 0.76 which we would not consider statistically significant since the t value was only 0.59. This information is dealt with more fully in Table 1.

A third check was made on the abilities of these two groups. This time they were compared on their study ability by comparing their scores on the study questions which also appeared in the final test. Here again the same two groups were of practically equal ability, as the reader can find by examining Table 2. It will be noted in examining Table 2 that no standard error of a mean is greater than 0.39 and when a cross comparison of these scores was made, it was found that no t value was greater than 0.52. It can therefore safely be assumed that the two groups do not differ significantly since their abilities have been checked on two different types of tests. These were, a test constructed to measure an individual's knowledge of a group of facts and a test constructed to aid the student in his study of a similar body of knowledge.

Table 1. A comparison of the abilities of the two groups on the pretest.

	N	$\bar{X}$	Median	S	$\sigma_{\bar{x}}$	S.E.D.	t
Group I	42	31.22	31.88	5.32	0.84	0.76	0.59
Group II	46	30.76	31.33	4.38	0.65		

In the presentation of results, the following symbols were used:

N = The number of cases

$\bar{X}$ = The arithmetic mean

S = The standard deviation

$\sigma_{\bar{x}}$ = The estimate of the standard error of the mean

S.E.D. = The estimate of the standard error of the difference between two means.

t = The ratio of any normally distributed variate to its estimated standard error.

Table 2. A comparison of the ability of the two study groups.

		N	$\bar{X}$	Median	ΣX^2	S	$\sigma_{\bar{x}}$	
Group I	A. Guide & Check	87	20.89	21.67	3843	2.35	0.25	(a)
	B. Guide	46	21.17	22.25	2091	2.49	0.37	(b)
Group II	A. Guide	42	21.02	22.0	1882	2.48	0.39	(c)
	B. Guide & Check	89	20.83	21.82	3913	2.37	0.25	(d)

$\bar{X}(a) - \bar{X}(d) = 0.05$	S.E. of Diff. of $\bar{X}$'s = 0.51	t = 0.11
$\bar{X}(b) - \bar{X}(c) = 0.15$	S.E. of Diff. of $\bar{X}$'s = 0.54	t = 0.27
$\bar{X}(a) - \bar{X}(c) = -0.14$	S.E. of Diff. of $\bar{X}$'s = 0.45	t = 0.32
$\bar{X}(d) - \bar{X}(b) = -0.34$	S.E. of Diff. of $\bar{X}$'s = 0.66	t = 0.52

It was the writer's desire to find the value of the check-up device which includes the guide questions and compare this value with that of the guide questions alone. A comparison of these values is shown in Table 2. As shown in Table 3, the scores achieved on the final examination were very nearly the same for the group using only the guide and for the group using the immediate check-up. A closer look into the values of the two study aids may be obtained from Table 4. This is a statistical breakdown of Table 3. It combines the scores from the two sub-groups which used the guide questions only, into one group. The second group was made up of the two sub-groups of students who had used the guide questions and the check-up Chemo-Score Sheet. It will be noted upon examination of this table that the difference between these two study methods was again very slight. The standard error of the difference between the means of these two groups was 1.300 with a t value of 0.43. There was a positive advantage shown in favor of the group using the check-up but this gain is not statistically significant. The small magnitude of the difference in the two study aids appears to be attributable, first, to lack of practice in the use of the Chemo-Score pen and answer sheet and second, to the fact that when the Perfo test was taken, each group had already taken that part of the test in which they had used the Chemo-Score, thereby being exposed to relevant material which might be applicable to the Perfo-Score which came after. The similarity of the two scores is here attributed to inadequate facility in the Chemo-Score technique. That lack of such practice is probably responsible for the seeming smallness

Table 3. A comparison of the results of the two study groups of questions on the final examination.

		: $\bar{X}$	: Median	: S	: $\sigma_{\bar{x}}$	
Group I	A. Guide & Check - Final	20.09	20.97	3.77	0.42	(a)
	B. Guide - Final	18.54	19.47	3.06	0.48	(b)
Group II	A. Guide - Final	20.66	21.61	3.01	0.44	(c)
	B. Guide & Check - Final	20.23	21.15	2.70	0.28	(d)

$\bar{X}_a - \bar{X}_d = 0.15$	S.E.D.(a-d) = 0.54	t = 0.24
$\bar{X}_b - \bar{X}_c = 2.12$	S.E.D.(b-c) = 0.62	t = 3.45
$\bar{X}_a - \bar{X}_c = 0.58$	S.E.D.(a-c) = 0.63	t = 0.91
$\bar{X}_d - \bar{X}_d = 1.70$	S.E.D.(d-b) = 0.54	t = 3.12

Table 4. A statistical breakdown of Table 3, combining Groups I-A and II-B to form one group and combining Groups I-B and II-A to form a second group.

Groups I-A, II-B		Groups I-B, II-A
ΣX	= 3549	1731
N	= 176	88
$\bar{X}$	= 20.22	19.67
Median	= 21.13	20.56
S	= 2.70	3.22
$\sigma_{\bar{x}}$	= 0.20	0.35

$\bar{X}_1 - \bar{X}_2 = 0.55$

S.E.D.(1-2) = 1.30

t = 0.43

of the contribution of the Chemo-Score Sheet is indicated in a study by H. J. Peterson (1935). In a prolonged study of the effect of the immediate Chemo-Score check-up on classroom learning, he divided a class into two groups for two periods each, covered by four unit tests and a half-term test. Group A used the text, guide questions, and Chemo-Score Sheets during the first half-term period, and Group B used only the text, guide questions, and Perfo-Score Answer Sheets. After the mid-term the two groups were interchanged and four additional unit tests and a second half-term test were given. In all of these tests the group using the Chemo-Score surpassed the group using only the Perfo Answer Sheet and all the differences were highly significant except the first. The difference between the two means on the first unit test was 1.85 in favor of Group A, the informed group, and the probable error of the difference between the means was 1.62 with a critical ratio of 1.14. On the second test, however, after Group A had become proficient in the use of the Chemo-Score, the difference of the means became 8.10 with a probable error of 1.80 and a critical ratio of 4.50. Further practice increased the critical ratio to 7.50 on the third test. This result was found after Group A had the practice necessary for getting the full value of this check-up device.

Table 5 points out some value of the check-up. This was accomplished by comparing the number of times students missed on the final, questions which had been missed on the guide, and lastly the number of times students missed questions on the final which had been missed on the preliminary test. It should be noted

Table 5. A comparison of scores of questions which appeared on all forms of the experiment.

	X	$\bar{X}$	S	$\sigma_{\bar{X}}$
a. Number of questions missed on the final which were also missed on the pretest by the 88 subjects.	549	6.24	3.23	0.35
b. Number of questions missed on the final which were also missed on the check-up.	138	1.57	1.49	0.16
c. Number of questions missed on the final which were missed on the guide.	233	2.65	2.08	2.22

$\bar{X}_a - \bar{X}_b = 4.67$ S.E.D.(a-b) = 0.32 t = 14.78

$\bar{X}_b - \bar{X}_c = 1.08$ S.E.D.(b-c) = 0.94 t = 1.15

$\bar{X}_a - \bar{X}_c = 3.59$ S.E.D.(a-c) = 0.35 t = 10.21

here that the data of Table 5 deal with the number that were missed in the specific instances indicated and not with the number correct. It will be observed that the difference between the means of Groups II and III was 1.08±0.94 with a t value of 1.150. This, of course, is again not statistically significant, but it is in favor of the check-up.

The difference between the means of Group I, the pretest group; and Group II, the check-up group, was 4.67±0.32 with a t value of 14.78. This is a very significant difference in favor of the check-up group. As a result of this difference, it seems justifiable to draw the conclusion that a student's knowledge of the results of his chosen answer is a real aid to learning.

DISCUSSION AND CONCLUSIONS

All comparisons made in this experiment between groups which had used the self-check-up and groups which had not used it have shown a slight, but statistically insignificant advantage in favor of the self-check-up.

It will be remembered that the purpose of the experiment was to test the Chemo-Score in a situation that would be comparable to an industrial situation. The results of the experiment have shown that there may be a possibility for its use as a training aid. Evidences of the value of this device for training in industry are pointed out in the studies of B. H. Fleenor and H. J. Peterson. Although their experiments were not carried out in an industrial situation, the learning goals and processes are simi-

lar enough to indicate that this device for self-instruction would be useful in industry.

Many industrial training programs, especially those dealing with safety, are of the same nature as the classroom situation where an instructor gives the students an outside reading assignment and later tests them over the information contained in that assignment. This being the case it would seem feasible that a safety instructor could improve his program by the use of this device in his training program. It is evident, however, that the person to be trained would first have to be thoroughly familiarized with the use of this self-instruction device.

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APPENDIX

PRELIMINARY TEST

1. When driving at night you should have (1. as little light as possible; 2. as much light as possible) on your side of the windshield.

2. Our reaction to a visual stimulation becomes possible when the nerve impulse reaches (1) the brain; 2. the spinal cord).

3. We would receive the clearest image of a fast flying airplane in daylight if we were (1. 100 ft; 2. 500 ft; 3. 1000 ft.) from that plane.

4. When we walk from a brightly illuminated room into a darkened room our eyes must make an adjustment for us to see in the dark. They do this by (1. enlarging the pupil to let in more light; 2. shifting over to a more sensitive set of light-detectors; 3. they do both).

5. Dials on the dash board of an automobile are painted with radium because the light given off by this paint will not affect night vision. (1. true; 2. false)

6. For the best possible vision at night you should (1. fixate directly what you want to see; 2. fixate a location a little to one side of what you want to see).

7. If you have a glare on your windshield from the lights inside of your car, the better way to reduce the glare is to (1. move your head further back from the glass; 2. move your head close to the glass; 3. neither of these).

8. Fatigue has a greater effect on (1. night vision; 2. day vision).

9. The color of a light can be distinguished only when the light is falling upon the (1. retina; 2. cornea; 3. iris).

10. When two colors, with the right amounts of each, mix together to produce gray; they are called (1. complementary; 2. supplementary; 3. neither complementary nor supplementary).

11. As our eyes become adjusted to the dark they perceive the color red as getting (1. brighter; 2. darker).

12. Color blindness is more often a visual defect of (1. men; 2. women).

13. We can truthfully say that the color-blind pilot is definitely handicapped. (1. true; 2. false).

14. For letters printed on a highway to be read by a driver, the characteristic least emphasized should be (1. height; 2. width).

15. An increase in age brings about a change in our eyes, this change makes our lens become (1. more elastic; 2. less elastic).

16. Looking back and forth between light and dark objects is (1. helpful; 2. hurtful) when the eye is fatigued.

17. Impulses from the left side of the right eye travel to the (1. left hemisphere; 2. right hemisphere) of the brain.

18. We see colors by means of the (1. rods; 2. cones).

19. If you are looking for something in the dark, the best way to locate it is to (1. scan one section of the area at a time; 2. sweep your eyes over the whole area; 3. neither of these).

20. Eating the proper foods will help us see better at right. Which of the following is the least helpful to night vision? (1. carrots; 2. potatoes; 3. cheese)

21. Light is (1. visible; 2. invisible) if one views it directly from the side.

22. If we were to view pure red and pure yellow lights through blue goggles we would see (1. an orange light; 2. green light; 3. no light at all).

23. For an object to appear white it must be able to (1. reflect; 2. absorb) every color that it receives.

24. Complete color blindness among men is frequent. (1. true; 2. false)

25. The stop signal of a traffic light is usually the (1. top; 2. bottom) light.

26. There are no varying degrees of color blindness. Either a person can see all colors or he can see none. (1. true; 2. false)

27. Correctly adjusted polaroid sun glasses cut out the light that vibrates (1. vertically; 2. horizontally; 3. both vertically and horizontally; 4. neither vertically nor horizontally).

28. Seeing is possible only when a clear image is thrown onto the (1. iris; 2. retina; 3. pupil) of the eye.

29. When you are looking at nearby objects, the lens muscle has to keep (1. relaxed; 2. contracted).

30. Distance is more accurately and speedily judged by (1. one-eyed; 2. two-eyed) people.

31. Intricate eye-muscle coordination (1. can be learned; 2. have to be learned; 3. both can and have to be learned; 4. are inherited).

32. When we are in twilight or bright moonlight the (1. rods; 2. cones; 3. both rods and cones) are functioning.

33. When moving from a brightly illuminated area into a darkened area the first thing to happen after you temporary blindness is (1. the cones become more sensitive; 2. the pupils dilate; 3. the rods get adjusted).

34. The saturation of a color (1. increases; 2. decreases; 3. remains the same) when new colors are mixed with it.

35. A pilot attacks with the sun to his back because (1. the target is more visible; 2. his plane is less visible; 3. both of these; 4. neither of these).

36. Which requires the greater exertion of the lens muscles? (1. near vision; 2. far vision).

37. By means of the rods we see (1. the brightness; 2. the colors) of objects.

38. There are many recommendations for adapting the eye to work in the dark. The best preparation for vision in darkness is (1. use of red goggles; 2. stay in a room illuminated by a red light; 3. remain in complete darkness).

39. The faster a driver goes (1. the more; 2. the less;) his attention deviates from the direction he is driving.

40. The distance ahead at which the driver is focusing his vision (1. varies directly with; 2. is proportional to; 3. varies inversely with) the speed at which he is driving.

41. From the sides of the eyes (1. red; 2. blue) is least readily seen.

42. When an approaching car is 800 feet away you can judge its speed accurately (1. true; 2. false).

43. We see an object only when our eyes and that object are standing still in relation to each other. (1. true; 2. false).

44. The time to sound your horn when passing another car in your lane is (1. when you are alongside the car; 2. behind the car).

45. We can safely assume that a pedestrian can get out of our way if he is beyond the distance we travel during the average response time. (1. true; 2. false)

46. The number of accidents at night is greater than the number of daylight accidents. This is caused by the greater number of automobiles in use at night. (1. true; 2. false).

47. When driving at night we can have assured safety when we follow the speed limitations set down for us. (1. true; 2. false).

48. The cones and rods of the eye are found in the (1. iris; 2. cornea; 3. retina).

49. At night the (1. cones; 2. rods) are used constantly.

50. Night vision is predominately (1. scotopic vision; 2. photopic vision).

51. The majority of our automobile accidents occur (1. in crowded traffic lanes; 2. on the highway).

52. The clarity of details which are seen diminishes as speed increases. Therefore as the speed decreases, objects passing the field of vision become (1. more distinct; 2. less clear).

53. When the speed exceeds 60 miles per hour, practically everything at the sides of the eye is (1. less; 2. more) effectively seen.

54. While passing an automobile you are (1. safe; 2. unsafe) when you can perceive motion in an oncoming car.

55. Objects, whether still or moving, are stimuli that slow up response to other stimuli. (1. true; 2. false)

56. The reaction which requires us to discriminate, to decide and then to move is exceptionally (1. fast; 2. slow).

57. On winding roads our vision is more limited than our hearing. (1. true; 2. false)

58. We least often perceive correctly the direction of a sound when it comes from a source (1. straight ahead; 2. to the left; 3. in between).

59. Familiarity with a highway might make driving safer in which of the following situations? (1. night driving; 2. driving in a fog; 3. driving during a snow storm.)

60. The retina is a sensitive nerve structure of the eye which contains the cells responsible for visions. (1. true; 2. false).

61. It takes a person a much longer time to adapt to the dark than it does to adapt to a bright light. (1. true; 2. false).

62. For avoidance of collision with other cars, peripheral vision is of greater importance when (1. driving on the highway; 2. driving in crowded traffic lanes).

63. As speed increases, the point of visual fixation moves (1. closer; 2. farther away).

64. The faster you drive the (1. clearer; 2. less clear) becomes your perception of objects near at hand.

65. The faster we travel the (1. more clear; 2. less clear) becomes our peripheral vision.

66. The number of things in one's field of vision has an effect on the quickness with which he can decide what to do. (1. true; 2. false).

67. With practice an inexpert driver can speed up a simple response where quicker response is needed. (1. true; 2. false).

68. The distance at which the eyes are focused is greater in the (1. night; 2. day).

69. At the fovea the rods are found in greater numbers than in any other part of the retina. (1. true; 2. false).

70. When we are confronted with a very bright light our (1. cones; 2. rods) are of little use.

71. The pupil of the eye (1. dilates; 2. constricts) considerably when confronted with a bright light.

72. Accidents involving pedestrians are brought about mainly by the physical limitations of the (1. driver; 2. pedestrian).

73. At moderate speeds, it takes the eye of a driver about (1. 1/8; 2. 1/16; 3. 1/32; 4. 1/64 of a second after it fixates a simple object, to perceive it.

74. We react slightly quicker to auditory stimulation than we do to visual stimulation. (1. true; 2. false).

75. When we move from a brightly lighted area into a darkened area the physiological change which permits vision is (1. photopic adaptation; 2. scotopic adaptation).

STUDY TEST

H.T.

1. Accidents involving pedestrians are brought about mainly by the physical limitations of the (1. driver; 2. pedestrian). (p. XV)

2. As speed increases, the point of visual fixation moves 3. closer; 4. farther away). (p. 2)

3. At 45 miles per hour, the average driver is focusing his eyes (2. 1/16; 3. 1/8; 4. 1/4; 5. 1/2) of a mile ahead. (p. 8)

4. The faster you drive the (1. less clear; 2. clearer) becomes your perception of objects near at hand. (p. 12)

5. The faster we travel the (2. more clear; 3. less clear) becomes our peripherial vision. (p. 18)

6. It is easier to distinguish (2. blue from yellow; 3. red from green) when seen from the sides of the eyes. (p. 19)

7. In visual perception (3. we actually see motion; 4. we infer motion). (p. 25)

8. After you perceive motion in an approaching car, the time for passing cars in your lane has passed. (3. true; 4. false). (p. 29)

9. The number of things in one's field of vision has no effect on the quickness with which he can decide what to do. (4. true; 5. false). (p. 38)

10. With practice an inexpert driver can speed up a simple response where quicker response is needed. (1. true; 2. false). (p. 46)

11. At moderate speeds, it takes the eye of a driver about (1. 1/8; 2. 1/16; 3. 1/32; 4. 1/64) of a second after it fixates a simple object, to perceive it. (p. 33)

12. In one of the experiments explained by Thurstone, the time required to respond to two different stimuli was shorter for the (1. men; 2. women). (p. 43)

13. "At 60 mph a car covers 83 ft. a second."
"At 30 mph a car covers 44 ft. a second."
On the basis of these statements, if a car were traveling 20 mph a pedestrian would have a good chance to get out of its path when the car was 25 feet away. (4. true; 5. false).

14. "If the automobile is traveling at 60 mph, the average pedestrian is not safe within 120 feet."
"If the automobile is traveling at 30 mph, the average pedestrian is not safe within 60 feet."
On the basis of these statements, what would be a safe distance for the average pedestrian to cross the street if the automobile is proceeding at 20 mph? (2. 50 feet; 3. 40 feet; 4. 30 feet). (p. 48)

15. Which stimulus waves travel faster through space? (1. sound; 2. light).

16. Which of the following does the author say is more often responsible for night accidents? (2. poor brakes; 3. fatigue; 4. headlight glare). (p. 59)

17. We react slightly quicker to auditory stimulation than we do to visual stimulation. (1. true; 2. false). (p. 53)

18. The distance at which the eyes are focused is greater in the (1. day; 2. night). (p. 59)

19. The authors agree that some people can drive better at night than they can in the daylight. (2. true; 3. false). (p. 61)

20. At the fovea the rods are found in greater numbers than in any other part of the retina. (3. true; 4. false). (p. 61)

21. When we are confronted with a very bright light our (2. cones; 3. rods) are of little use. (p. 62)

22. The pupil adapts quicker to a (2. brightening; 3. darkening) of illumination. (p. 62)

23. When we move from a brightly lighted area into a darkened area the physiological change which permits vision is (4. photopic adaptation; 5. scotopic adaptation). (p. 62)

24. The pupil of the eye (2. dilates; 3. constricts) considerably when confronted with a bright light. (p. 63)

25. The authors say that at the speed of (3. 35 to 40 miles per hour; 4. 40 to 45 miles per hour; 5. 45 to 50 miles per hour) a driver can find the greatest protection for himself against other drivers on the highway. (p. 68)

STUDY TEST

P.F.

1. The authors say that the broken circle eye test used by the Army is good because (1. it does away with guessing; 2. lessens guessing; 3. it isn't necessary for the subject to know how to read; 4. is necessary for the subject to know how to read). (p. 24)

2. Which light is least harmful to the eye? (2. intense; 3. dim; 4. moderate). (p. 28)

3. When the light rays are broken up and scattered, the image is distorted and blurred, or is dimmed out. This is called (3. broken vision; 4. glare). (p. 29)

4. To see textures or surface irregularities your light should be (1. as far to one side of you; 2. as far behind you) as possible. (p. 27)

5. A pilot attacks with the sun to his back because (1. the target is more visible; 2. the plane is less visible; 3. both; 4. neither). (p. 30)

6. Seeing is possible only when a clear image is thrown onto the (1. iris; 2. retina; 3. pupil) of the eye. (p. 29)

7. When you are looking at nearby objects, the lens muscle has to keep (3. relaxed; 4. contracted). (p. 32)

8. Correctly adjusted polaroid sun glasses cut out the light that vibrates (2. vertically; 3. horizontally; 4. both; 5. neither). (p. 30)

9. Impulses travel along the fibers of the optic nerve at a rate (4. slower; 5. faster) than a speeding car does on a highway. (p. 34)

10. Which requires the greater exertion of the lens muscles? (1. near vision; 2. far vision). (p. 34)

11. While reading a book, it is best that we (1. keep only the book lighted; 2. keep the room and the book lighted; 3. keep the whole room lighted). (p. 37)

12. Individual differences in men are large enough to be of practical consequence. (1. true; 2. false). (p. 58)

13. Distance is more accurately and speedily judged by (4. one-eyed; 5. two-eyed) people. (p. 41)

14. If the distance between you and an object is rather large, with the object still in your range of vision, then the size of the object is of little importance in judging that distance. (2. true; 3. false) (p. 41)

15. Eye-muscle coordination must be learned before complex reactions can be performed. (2. true; 3. false) (p. 59)

16. Intricate eye-muscle coordinations (2. can be learned; 3. have to be learned; 4. both can and have to be learned; 5. are inherited. (p. 59)

17. The rods are insensitive to which of the following hues at night when these hues are in their pure state? (1. red; 2. green; 3. blue). (p. 63)

18. By means of the rods we see (1. the brightness; 2. the colors) of objects. (p. 63)

19. When we are in twilight or bright moonlight the (1. rods; 2. cones; 3. both rods and cones) are functioning. (p. 61)

20. There are many recommendations for adapting our eye to work in the dark. The best preparation for vision in darkness is (2. to use red goggles; 3. to stay in a room illuminated by a red light; 4. to remain in complete darkness). (p. 65)

21. When moving from a brightly illuminated area into a darkened area the first thing to happen after your temporary blindness is (2. the cones become more sensitive; 3. the pupils dilate; 4. the rods get adjusted). (p. 65)

22. As we become fatigued the amount of light necessary for vision is (1. decreased; 2. increased; 3. neither decreased nor increased). (p. 74)

23. The color which has the longest wave-length is (3. violet; 4. green; 5. red). (p. 81)

24. The saturation of a color (2. increases; 3. decreases; 4. remains the same) when new colors are mixed with it. (p. 81)

25. Most color blind people can distinguish the colors of a traffic signal because of (3. practice in using these lights; 4. the brightness of these lights). (p. 109)

FINAL EXAMINATION

F.E.

1. When driving at night you should have (1. as little light as possible; 2. as much light as possible) on your side of the windshield.

2. Our reaction to a visual stimulation becomes possible when the nerve impulse reaches (1. the brain; 2. the spinal cord).

3. We would receive the clearest image of a fast flying airplane in daylight if we were (1. 100 feet; 2. 500 feet; 3. 1000 feet) from that plane.

4. When we walk from a brightly illuminated room into a darkened room our eyes must make an adjustment for us to see in the dark. They do this by (1. enlarging the pupil to let in more light; 2. shifting over to a more sensitive set of light detectors; 3. they do both).

5. Dials on the dash board of an automobile are treated with radium paint because the light given off by this paint will not affect night vision. (1. true; 2. false)

6. For the best possible vision at night you should (1. fixate directly what you want to see; 2. fixate a location a little to one side of what you want to see).

7. If you have a glare on your windshield from lights inside of your car, the better way to reduce the glare is to (1. move your head further back from the glass; 2. move your head close to the glass; 3. neither).

8. Fatigue has a greater effect on (1. night vision; 2. day vision).

9. The color of a light can be distinguished only when the light is falling upon the (1. retina; 2. cornea; 3. iris).

10. When two colors, with the right amounts of each mix together to produce gray, they are called (1. complementary; 2. supplementary; 3. neither complementary nor supplementary).

11. As our eyes become adjusted to the dark they perceive the color red as getting (1. brighter; 2. darker).

12. Color blindness is more often a visual defect of (1. men; 2. women).

13. We can truthfully say that color-blind pilots are definitely handicapped. (1. true; 2. false)

14. The authors say that the broken circle eye test used by the Army is good because (1. it does away with guessing; 2. lessens guessing; 3. it isn't necessary for the subject to know how to read; 4. it is necessary for the subject to know how to read).

15. To see texture or surface irregularities your light should be (1. as far to one side of you; 2. as far behind you) as possible.

16. Which light is least harmful to the eye? (1. intense; 2. dim; 3. moderate)

17. When the light rays are broken up and scattered, the image is distorted and blurred, or is dimmed out. This is called (1. broken vision; 2. glare).

18. Impulses travel along the fibers of the optic nerve at a rate (1. faster; 2. slower than a speeding car does on a highway.

19. While reading a book, it is best that we keep the room in darkness except for the lamp we use to read the print. (1. true; 2. false)

20. If the distance between you and an object is rather large, with the object still in your range of vision, then the size of the object is of little importance in judging that distance. (1. true; 2. false)

21. Individual differences in men are large enough to be of practical consequence. (1. true; 2. false)

22. Eye-muscle coordination must be learned before complex reactions can be performed (1. true; 2. false)

23. The rods are insensitive to which of the following hues at night when these hues are in their pure state? (1. red; 2. green; 3. blue)

24. As we become fatigues the amount of light necessary for vision is (1. increased; 2. decreased; 3. neither increased nor decreased).

25. The color which has the longest wave-length is (1. red; 2. green; 3. violet).

26. Most color blind people can distinguish the colors of a traffic signal because of (1. practice in using these lights; 2. the brightness of these lights).

27. A pilot attacks with the sun to his back because (1. the target is more visible; 2. the plane is less visible; 3. both of these; 4. neither of these).

28. Which requires the greater exertion of the lens muscles? (1. near vision; 2. far vision)

29. By means of the rods we see (1. the brightness; 2. the colors) of objects.

30. There are many recommendations for adapting the eye to work in the dark. The best preparation for vision in darkness is (1. use of red goggles; 2. stay in a room illuminated by a red light; 3. remain in complete darkness).

31. Correctly adjusted polaroid sun glasses cut out the light that vibrates (1. vertically; 2. horizontally; 3. both vertically and horizontally; 3. neither vertically nor horizontally).

32. When you are looking at nearby objects, the lens muscle has to keep (1. relaxed; 2. contracted).

33. Intricate eye-muscle coordinations (1. can be learned; 2. have to be learned; 3. both can and have to be learned; 4. are inherited).

34. When moving from a brightly illuminated area into a darkened area the first thing to happen after your temporary blindness is (1. the cones become more sensitive; 2. the pupil dilates; 3. the rods get adjusted).

35. When we are in twilight or bright moonlight the (1. rods; 2. cones; 3. both rods and cones) are functioning.

36. Seeing is possible only when a clear image is thrown onto the (1. iris; 2. retina; 3. pupil) of the eye.

37. The saturation of a color (1. increases; 2. decreases; 3. remains the same) when new colors are mixed with it.

38. Distance is more accurately and speedily judged by (1. one-eyed; 2. two-eyed) people.

39. A contrast in color hues is alone enough to make objects stand out. (1. true; 2. false)

40. There are numerous ways to cure the eye of fatigue but the best cure is (1. a boric acid eye bath; 2. rest).

41. It requires a greater effort for a normal eye muscle to focus on (1. a far object; 2. a near object).

42. In normal vision the view perceived by one eye is slightly different from the view perceived by the other eye. (1. true; 2. false)

43. The only time the size of the pupil changes is when illumination changes (1. true; 2. false)

44. It is possible to make objects stand out by using (1. different colors; 2. different brightness values; 3. both different colors and different brightness values).

45. The two colors which are usually the most difficult for a color blind person to distinguish are (1. blue from yellow; 2. red from blue; 3. red from green).

46. The closer you are to an object, the (1. slower; 2. faster) are the speeds at which it can be seen clearly as moving.

47. When the muscles of the eye are relaxed, the eye is at rest and is focused on objects (1. near by; 2. far away).

48. The amount of light necessary for reading (1. varies directly with; 2. is proportional to; 3. varies inversely with) the size of the print on the reading material.

49. Some men are less able to see distinctly with bright light in their eyes than are others. (1. true; 2. false)

50. An increase in age brings about a change in our eyes. This change usually appears in the (1. retina; 2. lens; 3. iris).

51. Looking back and forth from light to dark objects is helpful when the eyes are fatigued. (1. true; 2. false)

52. The faster a driver goes, (1. the more; 2. the less) his attention deviates from the direction he is driving.

53. The distance ahead at which the driver is focusing his vision (1. varies directly with; 2. is proportional to; 3. varies inversely with) the speed at which he is driving.

54. From the sides of the eyes (1. red; 2. blue) is least readily seen.

55. When an approaching car is 800 feet away, you can judge its speed accurately. (1. true; 2. false)

56. We see an object only when our eyes and that object are standing still in relation to each other. (1. true; 2. false)

57. The time to sound your horn when passing another car in your lane is (1. when you are alongside the car; 2. behind the car).

58. We cannot safely assume that a pedestrian can get out of our way using average response times laid down by the author. (1. true; 2. false).

59. The number of accidents at night is greater than the number of daylight accidents. This is caused by the greater number of automobiles in use. (1. true; 2. false)

60. When driving at night we can have assured safety when we follow the speed limitations set down for us. (1. true; 2. false).

61. The cones and rods of the eye are found in the (1. iris; 2. cornea; 3. retina).

62. At night the (1. cones; 2. rods) are used constantly.

63. Night vision is predominately (1. scotopic vision; 2 photopic vision).

64. At 45 miles per hour, the average driver is focusing his eyes (1. 1/10; 2. 2/10; 3. 3/10; 4. 4/10) of a mile ahead.

65. It is easier to distinguish (1. blue from yellow; 2. red from green) when seen from the sides of the eyes.

66. In visual perception (1. we actually see motion; 2. we infer motion).

67. After you perceive motion in an approaching car, the time for passing cars in your lane has passed. (1. true; 2. false)

68. In one of the experiments explained by Thurstone, the time required to respond to two different stimuli was shorter for the (1. women; 2. men).

69. "If the automobile is traveling at 60 mph, the average pedestrian is not safe within 120 feet."
"If the automobile is traveling at 30 mph, the average pedestrian is not safe within 60 feet."
On the basis of these statements, what would be a safe distance for the average pedestrian to cross the street if the automobile is proceeding at 20 mph? (1. 50 feet; 2. 40 feet; 3. 30 feet)

70. "At 60 mph a car covers 88 feet a second."
"At 30 mph a car covers 44 feet a second."
On the basis of these statements, if a car were traveling 20 mph a pedestrian would have a good chance to get out of its path when the car was 25 feet away. (1. true; 2. false)

71. Which stimulus waves travel faster through space? (1. sound; 2. light)

72. Which of the following does the author say is more often responsible for night accidents? (1. poor brakes; 2. fatigue; 3. headlight glare).

73. The authors agree that some people can drive better at night than they can in the daylight. (1. true; 2. false)

74. The pupil adapts quicker to a (1. brightening; 2. darkening) of illumination.

75. The authors say that at the speed of (1. 35 to 40 miles per hour; 2. 40 to 45 miles per hour; 3. 45 to 50 miles per hour) a driver can find the greatest protection for himself against other drivers on the highway.

76. Accidents involving pedestrians are brought about mainly by the physical limitations of the (1. driver; 2. pedestrian).

77. At moderate speeds, it takes the eye of a driver about (1. 1/8; 2. 1/6; 3. 1/32; 4. 1/64) of a second after it fixates a simple object, to perceive it.

78. We react slightly quicker to auditory stimulation than we do to visual stimulation. (1. true; 2. false)

79. When we move from a brightly lighted area into a darkened area the physiological change which permits vision is (1. phototopic adaptation; 2. scotopic adaptation).

80. The faster you drive the (1. clearer; 2. less clear) becomes your perception of objects near at hand.

81. When we are confronted with a very bright light our (1. cones; 2. rods) are of little use.

82. As speed increases the point of visual fixation moves (1. closer; 2. farther away).

83. The distance at which the eyes are focused is greater in the (1. night; 2. day).

84. The number of things in one's field of vision has no effect on the quickness with which he can decide what to do. (1. true; 2. false)

85. With practice an inexpert driver can speed up a simple response where quicker response is needed. (1. true; 2. false)

86. At the fovea the rods are found in greater numbers than in any other part of the retina. (1. true; 2. false)

87. The pupil of the eye (1. dilates; 2. constricts) considerably when confronted with a bright light.

88. The faster we travel the (1. more clear; 2. less clear) becomes our peripheral vision.

89. It is (1. normal; 2. abnormal) for an individual to have clear peripheral vision.

90. Objects move faster in the field of vision (1. the closer; 2. the farther away) they are.

91. Motion is perceived only when the mind by various "cues" is able to help the eyes. (1. true; 2. false)

92. The term, distance receptor, does not include the organs of (1. hearing; 2. sight; 3. touch).

93. The (1. natural focal point; 2. forced focal point) of the eye is an unsuspected reason why many drivers try to pass every other driver.

94. The number of stimuli confronting a driver has no effect on the time it takes him to react to a situation. (1. true; 2. false)

95. The pupil of the eye will recover quicker from a (1. brightening; 2. darkening) of illumination.

96. The pupils of the eyes of a driver in daylight (1. expand; 2. become smaller; 3. remain unchanged) when his car increases in speed.

97. When two cars are approaching each other at 40 miles an hour they are (1. more than 10 seconds apart; 2. less than 10 seconds apart) when motion is first perceived.

98. On a straight highway in daylight our (1. vision; 2. hearing) is more limited.

99. As we become familiar with the art of driving we are (1. more safe; 2. less safe) when that activity becomes a habit.

100. In a controlled experiment it was found that the reaction time of a driver is quicker than the reaction time of a pedestrian in a typical traffic situation. (1. true; 2. false).

A STUDY OF THE VALUE OF A SELF-INSTRUCTION TEST AS A TRAINING AID

by

LODORICK PETER TROILO

B. S., Kansas State College
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AN ABSTRACT

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This investigation was conducted to determine the value of the Chemo-Score Self-Checking Answer Sheet as a training aid. It was hoped that this study aid could be used in an industrial situation whereby instruction in safety could be made more effective.

This experiment in learning covered the subject of highway safety which was chosen because of its prominence in our everyday lives.

The experiment was set up to include a preliminary test, a study test, and a final test. The study test was conducted in two parts so that each student would use the Chemo-Score as a study aid on the first part and the Perfo-Score as a study aid on the second part. In both sections of this test, the student had textbooks on hand for reference in addition to guide questions and study aids.

The preliminary test was administered by means of the Perfo-Score Answer Sheet. After the preliminary test had been taken by the students, they were assigned outside readings over the material covered in this experiment. They were told that they would have a test over this material but that during examination, they would have these assigned books for reference.

Full instructions were given to the students in the use of the Chemo-Score Answer Sheet before the study tests were administered. The students were given a practice question and were allowed time to observe the results and distinguish between the

blue dot for a correct answer and the red dot for an incorrect answer.

Since the students were familiar with the Perfo-Score Answer Sheet but were not acquainted with the Chemo-Score Answer Sheet, considerable difficulties were encountered in the manipulative and interpretative use of the Chemo-Score which were not found in the Perfo-Score. These difficulties found in using the Chemo-Score can be avoided only by thoroughly familiarizing the user with this device.

The final examination, consisting of all the questions of the study tests, 2/3 of the questions of the pretest, and 25 new questions, was administered by means of Perfo-Score Answer Sheets in the same manner as any other class test.

All comparisons made in this experiment between groups which had used the self-check-up and groups which had not used the check-up as a study aid have shown a slight, but statistically insignificant advantage in favor of the self-check-up.